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ANALYSIS OF SONAR TASKS: I. PRELIMINARY ANALYSIS OF SQS-4 OPERA--ETC(U)
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ANALYSIS OF SONAR TASKS: I. PRELIMINARY ANALYSIS OF SQS-4

OPERATOR PROCEDURAL TASKS.

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ANALYSIS OF SONAR TASKS: I. PRELIMINARY ANALYSIS OF SQS-4
OPERATOR PROCEDURAL TASKS

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Analysis of Sonar Tasks: I. Preliminary Analysis of SQS-4 Operator
Procedural Tasks

This preliminary analysis of SQS-4 operator procedural* tasks was made to meet an immediate need for this information as well as for long range planning as discussed in the introduction. This information is presented in this form as it may be useful to others at NEL and to a few outside activities. Although this is not a report, portions of this material may later become part of an NEL report.

The preliminary nature of this analysis coupled with developing doctrine and possible changing practices makes later revision desirable. Comments and suggestions are requested, and should be forwarded to Code 2143.

INTRODUCTION

A review of the trainer requirements for the AN/UQS-T2, the Group Operator Trainer known as GOT II, was requested by the Bureau of Ships under NEL Problem XI-2. Comprehensive descriptions of what a man does in his billet are essential to the design of efficient trainers. One purpose of this analysis was to provide this information.

Descriptive operator-task information is also needed under NEL Problem XI-11 to establish criteria for measuring sonar operator performance in order to determine effectiveness of sonar training devices and techniques as well as training material. On this basis, training devices that provide optimum effectiveness can be developed with a minimum of complexity.

The Personnel Research Field Activity, San Diego, has published Task Descriptions for a number of sonar equipments including QHBA and SQS-11a (PRFASD Report No. 58). However, no task description for SQS-4 sonar is available, and as far as can be determined none is being undertaken. The analysis was limited at this time to those phases of the sonar operator's job which would make the most contribution to the review of requirements for the GOT II. The results will be useful not only in this immediate problem, but also in the study of efficiency of sonar trainers under XI-11.

The format used in the present analysis is based on ideas obtained from PRFASD Report No. 58 as well as the Air Force Handbook, "A Method for Man-Machine Task Analysis" (WADC Technical Report 53-187). This analysis is based on logical grounds and should be followed by further analyses and experimental verification.

* Includes primarily the individual manipulative, tracking, and reporting tasks at the sonar stack only; does not include the more complex sensory discriminations of target classification nor the group behaviors of team activities.

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THE AN/SQS-4 SONAR SET

The AN/SQS-4 is a supersonic scanning sonar equipment. It is somewhat similar in appearance and operation to the QHB and the AN/SQS-10, 11 series of scanning sonar equipments. The SQS-4 differs from the SQS-10 in two general respects: (a) It has the potential for longer target detection ranges, and (b) The target bearing and range tracking functions previously performed by two equipments and two operators are now incorporated in the SQS-4 equipment which requires a single operator. The SQS-4 has the bearing tracking functions of the SQS-10 and the range tracking function with an accuracy said to be equivalent to that of the AN/SQA-4 range recorder.

Range and bearing tracking is accomplished by a single operator who tracks in bearing with his right hand and in range with his left hand. The tip of the cursor is positioned on the target pip by simultaneous adjustment of these range and bearing control knobs. This new feature involves other changes:

a. The addition of a DWELL TIME switch. The position of this switch determines how long the cursor will print on the scope between pings. The operator can make the necessary range and bearing adjustments of the cursor only during this dwell time.

b. The provision of Target Centered Display (TCD) in addition to Ship Centered Display (SCD). In SCD the cursor originates at the center of the scope as with the QHBA or SQS-10. The TCD off-centers the origin of the sweep and cursor and expands the display two and one-half times. In TCD the tip of the cursor always returns to the center of the scope at the beginning of the dwell time between pings.

AN/SQS-4 Controls

Altogether there are nineteen external controls, two dials, six pilot lights, and the scope on the AN/SQS-4 Control Indicator. To provide a more complete understanding of the operator's tasks these controls and indicators are listed below with a brief description. See Figure 1.

Most of the controls and indicators involved in search and tracking are located on the sloping surface of the Control-Indicator. They are as follows:

1. Pulse length switch - This switch provides for selection of long, medium, or short pulse transmission (80, 30, or 6 milliseconds).
2. Slew switches - There are four push buttons. The upper and lower buttons control slewing in range at a rate of approximately 800 yards per second. The upper button increases range and the lower button slews range in. The right button slews bearing clockwise and the left button slews bearing counterclockwise at a rate of approximately 48 degrees per second.
3. Full scale push button - Pushing this button allows the sweep to expand to the full extent of the range scale in use regardless of the cursor extension.

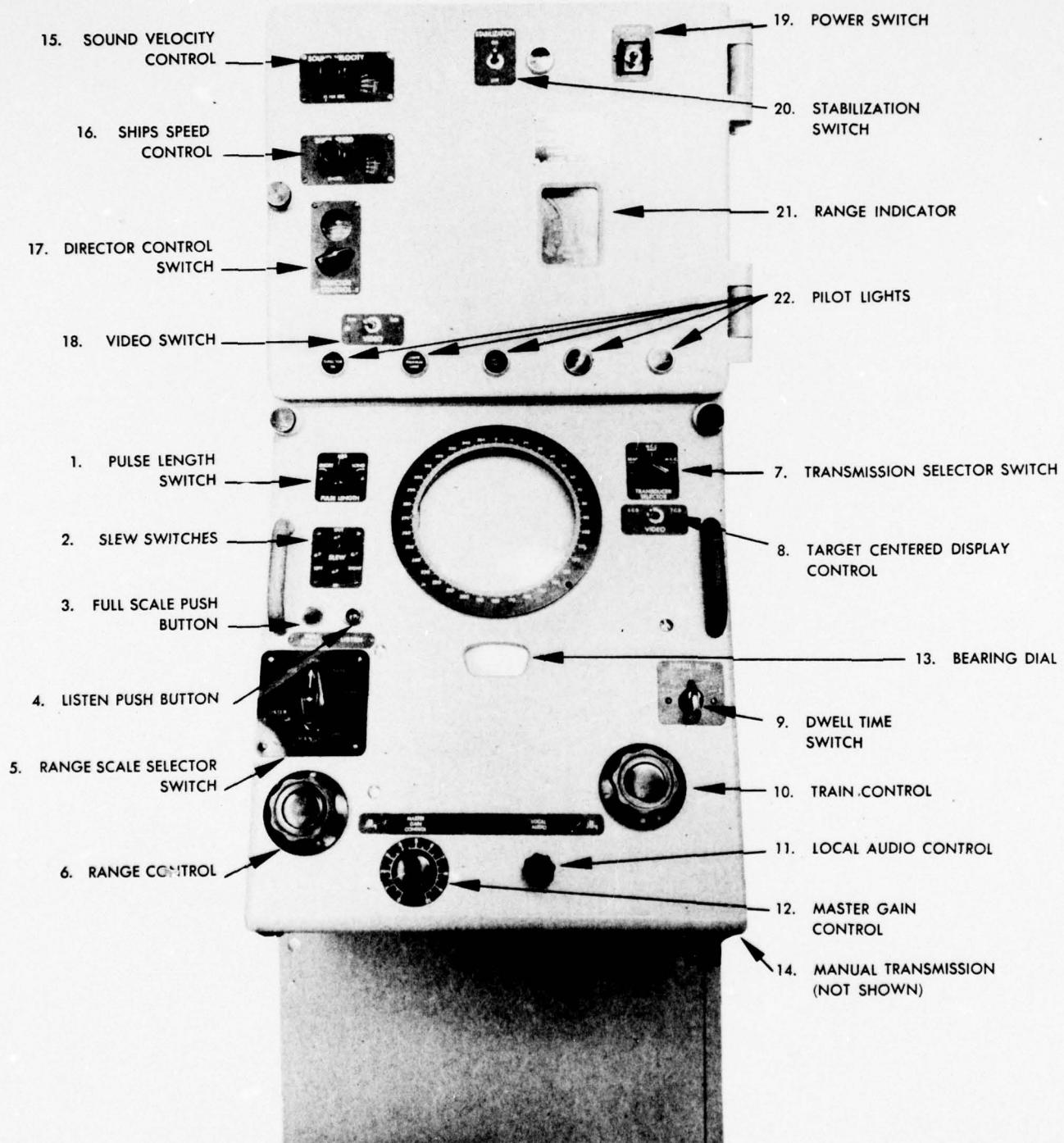


Figure 1

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4. Listen push button - Pushing this button interrupts transmission and puts the equipment in listening as long as the button remains depressed.

5. Range Scale Selector Switch - This six position switch provides for selection of 1000, 2500, 5000, 10,000 and 15,000 yard range scales and the listen position.

6. Range Control - This is the range tracking control. It controls the length of the cursor and the keying interval.

7. Transmission Selector Switch - This three position switch controls various combinations of transmission and reception of either a narrow beam in vertical plane or a broad depressed beam. The positions are: Normal, MCC-XMIT and MCC.

8. Target-Centered Display Control - This control permits selection of Ship-Centered Display or Target-Centered Display.

9. Dwell Time Control - This five position switch permits selection of dwell times ranging from $\frac{1}{4}$ seconds to $2\frac{1}{2}$ seconds except that on 1000 yard scale positions 2, 3, 4, and 5, all provide one second dwell time.

10. Train Control - This is the bearing-tracking control. It controls the bearing of the cursor.

11. Local Audio Control - This control regulates the output of the loudspeaker.

12. Master Gain Control - This control governs output of both video and audio channels.

13. Bearing Dial - This indicator shows the bearing to which the cursor is trained and thus the center of the sector from which audio signals are heard.

14. Manual Transmission - This control, not shown in Figure 1, is located on the right side of the console. This permits underwater communication when the range scale selector is in Listen position.

15. Sound Velocity Control - This control is set on the basis of the bathythermograph trace.

16. Ship's Speed Control - The ship's speed is set in by this control. The dial is calibrated in knots.

17. Director Control - This three position switch must be properly set to indicate when searching, when on target, and to DIRECTOR CONTROL to receive aided tracking.

18. Video Switch - This switch provides for selection of Sum Brightening or Difference Brightening.

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19. Power Switch - This is the off-on switch.

20. Stabilization Switch - The control permits turning off stabilization if faults develop which produce erratic performance.

21. Range Indicator - These dials permit reading range out to 15,000 yards.

22. Pilot Lights

a. Director On - Indicates aided tracking is provided.

b. XMTR Thermal Limit - Indicates that power output has been automatically reduced by overloading.

c. Gyro Off - Indicates display is in relative bearing.

d. MCC XMIT - Indicates transmission is on depressed beam.

e. MCC Receive - Indicates both transmission and reception are on depressed beam.

In addition to these external controls the operator uses Calibrative Controls located inside the console:

23. Intensity Control - This control is used to adjust the basic level of scope intensity.

24. Cursor Intensity - This is a separate control to regulate cursor intensity.

25. Gyro On-Off Switch - This control is used in calibrative adjustments.

26. Test Controls - This multi-position switch is used in carrying out certain regular checks and tests.

27. Local Power Switch

Note: Associated Communication Controls may vary between installations and are not included in the analysis.

THE ANALYSIS

The format used to report this preliminary analysis of AN/SQS-4 operator procedural tasks makes use of nine column headings as follows:

1. Descriptive Information

a. Task (Col. #1) - The procedural tasks are under eleven main headings and several sub-headings as shown in the Table of Contents.

b. Item No. (Col. #2) - This is a reference number used to identify related items in the various columns.

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c. Control Description (Col. #3) - This is simply the name of the control involved in the operator's action to be described.

2. Behaviors - These are the operator behaviors classified in three categories.

a. Control Action (Col. #4) - This column describes the action taken with respect to the particular control.

b. Report Action (Col. #5) - This column includes verbal reports of the operator.

c. Other Action (Col. #6) - All other pertinent operator behaviors are included.

3. Basis for Action - The following columns constitute the basis for the behaviors which have been described.

a. Goal - Criterion of Response Adequacy (Col. #7) - This column lists the goals toward which action is directed.

b. Display Cues (Col. #8) - The cues to which the operator must attend are listed in this column.

c. Special Orders, Doctrine, and General Knowledge (Col. #9) - This column includes specific and general information which the operator has and includes doctrine, procedures, general background information, special information, and direct orders.

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER AC
A. Prepare sonar stack for operation					
(1) Energize equipment	1		1. Open upper panel		
	2	2. Test Controls	2. Turn to OPERATE		
	3	3. "Local" Power Switch	3. Turn to ON		
	4		4. Close upper panel		
	5	5. Range Scale Selector Switch	5. Turn to LISTEN		
	6	6. Master Gain Control	6. Turn to zero		
	7	7. Power ON/OFF Switch	7. Turn to ON		
	8				8. Allow stack to up for $4\frac{1}{2}$ min.
		8.d. Master Gain Control	8.d. Adjust		
(2) Preliminary adjustments:					
(a) Scope Intensity	9	9. Master Gain Control	9. Turn to zero		
	10		10. Open upper panel		
	11	Intensity Control	11. Adjust Intensity Control		
(b) Cursor Intensity	12	12. Train Control	12. Depress		
	13	13. Cursor Intensity	13. Adjust		

VIORS		BASIS FOR ACTION		
ACTION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
		<p>2. Switch points to OPERATE</p> <p>3. Switch points to ON</p> <p>5. Switch points to LISTEN</p> <p>6. Switch on zero</p> <p>7. Switch points to ON</p> <p>8. Allow stack to warm up for $4\frac{1}{2}$ min.</p> <p>8. Stack operable</p> <p>9. Switch points to zero</p> <p>10. Panel OPEN</p> <p>11. Circular sweep on PPI is just below threshold of visibility</p> <p>12. Cursor appears</p> <p>13. Tip of cursor brighter than radial portion</p>	<p>8.a. Bearing and range indicators lit</p> <p>b. Power indicating lamp on (Red)</p> <p>c. After 12 seconds red light lit on RF amplifier, Signal Data Converter and Sonar Transmitter</p> <p>d. After 30 seconds audio presentation</p> <p>e. After 60 seconds video presentation</p>	<p>1. Firing up procedures</p> <p>9. Calibration and firing up procedures</p> <p>2</p>

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER ACTION
(c) Gyro check	14	14. Gyro ON/OFF Switch	14. Turn to ON		14. Request OS head check to see if head in agreement
	15	15. Gyro ON/OFF Switch	15. Turn to OFF	15. Notify Bridge & Maint. that sonar is operating in Relative Bearing.	15. Decide if this action is required
(d) Sensitivity Test (once each watch)	16	16. Test Controls	16. Turn to MEDIUM		
	17	17. Range Scale Selector Switch	17. Turn to LISTEN		
	18				18. If noise spoke does not appear notify Maintenance.
(e) Preamplifier Test (once each watch)	19	19. Test Controls	19. Turn to HIGH		
	20	20. Master Gain Control	20. Adjust for moderate brilliance		
	21	21. Video Switch	21. Turn to DIFFERENCE		
	22	22. Bearing Dial (above Test Switch)	22. Rotate slowly	22. If trace does not appear consistently, notify Maintenance	
	23		23. Close upper panel		

BASIS FOR ACTION				
ACTION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
edge & marker is relative	<p>14. Request OS heading; check to see if heading in agreement</p> <p>15. Decide if this action is required</p> <p>16. Switch points to Med.</p> <p>17. Switch points to Listen</p> <p>18. Noise spoke on PPI (after 60 sec.)</p> <p>19. Switch points to High</p> <p>20. Optimum brilliance</p> <p>21. Switch points to DIFF</p> <p>22. Trace on PPI tube must appear consistently at all bearings</p>	<p>14. OS heading checks with that indicated by Stern Cursor</p> <p>15. Satisfactory relative bearing operation</p> <p>16. (Own ships heading not in agreement with reported heading). Red gyro off lamp</p> <p>17. Noise spoke</p> <p>18. PPI video brilliance</p> <p>19. Trace on PPI tube</p>		

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER ACT
B. Prepare for search	1	1. Stabilization Switch	1. Turn to OFF		
	2	2. Transmission Selector Switch	2. Turn to SEARCH		
	3	3. VIDEO Switch	3. Turn to SUM		
	4	4. Ships Speed Control	4. Set to value of own ships speed		4. Check own ship speed
	5	5. Sound Velocity Control	5. Turn to appropriate value		
	6	6. PULSE LENGTH Switch	6. Turn to MED		
	7	7. Target Centered Display Control	7. Turn to SCD		
	8	8. DIRECTOR CONTROL Switch	8. Turn to SEARCH		
	9	9. DWELL TIME Switch	9. Turn to Position 1		
	10	10. RANGE SCALE SELECTOR Switch	10. Turn to scale including maximum range of the day		10. Determine start keying and sweep properly expanding
	11	11. Slew Switches	11. Push range (out, in) button. Slew to range approximately 500 yds beyond maximum range		
	12	12. MASTER GAIN Control	12. Turn to optimum level		12. Check appearance noise and reverbs
	13	13. Local Audio Control	13. Turn to optimum level		13. Check audio level
	14	14. TRAIN Control	14. Turn (left and right)		14. Determine control is operating properly

RS		BASIS FOR ACTION		
TION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
		1. Switch points to OFF 2. Switch points to SEARCH 3. Switch points to SUM 4. Check own ships speed 4. Match OS speed 5. Proper value 6. Switch points to MED 7. Switch points to SCD 8. Switch points to SEARCH 9. Switch points to Position 1 10. Determine stack is keying and sweep is properly expanding		1. Search Procedures 4. Reported value OS speed 5. Sound velocity 10. Range of Day 11. Range of Day
		10. Switch points to Optimum Range 11. Cursor in optimum range position	10. PPI video display	
		12. Check appearance of noise and reverbs	12. Appearance of noise and reverbs	
		13. Check audio signal level	13. Level of audio signal	
		14. Determine control is operating properly	14. Bearing Cursor; Stern Cursor	

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER
C. Conduct beam-to-beam search	1			1. Repeats order (verbatim)	1. Check no display
	2	2. Slew Switches	2. Depress button (left, right) - slews to beam ordered by Conn		2. Remain a signals
	3	3. Master Gain Control	3. Adjust		
	4	4. Train Control	4. Train forward in 5 steps		4. Use ping listen sequ
	5		5. Ping twice on bow		
	6	6. Slew Switches	6. Depress button (left, right) slews to opposite beam		
	7	7. Train Control	7. Repeat steps 4 & 5		7. Same as
	8	8.	8. Slew cursor to opposite beam and repeat steps 4, 5, 6 & 7.		8. Continue search until is made or is made by C

RS		BASIS FOR ACTION		
ITION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
	<p>1. Check mode of display</p> <p>2. Remain alert for signals</p> <p>4. Use ping-train listen sequence</p> <p>7. Same as 4</p> <p>8. Continue this type search until contact is made or until change is made by OOD</p>	<p>2. Cursor ON (port, starboard) beam</p> <p>3. Gain sufficiently high to detect possible contact and yet comfortable</p> <p>4. Detect signals while conducting beam-to-beam search</p> <p>6. Cursor on opposite beam</p> <p>7. Same as 4</p>	<p>3. Appearance of noise and reverbs</p> <p>6. Cursor position relative to bearing dial</p> <p>7. Same as 4</p>	<p>1. Conduct standard beam-to-beam search starting with (port or starboard) beam. Search Procedures</p>

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER ACT
D. Contact and Classification of Contact	1				
	2	2. Train Control	2. Train to blip		2. Interrupt standard beam-to-beam search
	3	3. Range Control	3. Train to blip		
	4	4. Master Gain Control	4. Adjust		4. Compare audio and video presentation memory of previous contacts
	5			5. Report Sonar Contact Bearing _____ Range _____	5. Determine range bearing from approach indicators
	6	6. Train Control	6. Train as required		6. Shift to ping-1 train sequence
	7				7. If bearing foul resume standard beam search; if bearing clear, classify
	8				8. Classify contact
	9	9. Train Control	9. Train (left, right) to after cut of target	9. Report after cut	9. Note audio and video presentation
	10	10. Pulse Length Switch	10. May turn to Long	10. Report: Doppler low, Doppler high; or no doppler	10. Determine probable target aspect (compute pitch of echo to range)
	11	11. Master Gain Control	11. May adjust		
	12	12. Train Control	12. Train (left, right) to target	12. Report leading cut	12. Note audio and video presentation
	13			13. Report target width	

ORS		BASIS FOR ACTION		
ACTION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
		1. Detect target 2. Interrupt standard beam-to-beam search 3. Cursor tip on blip within 4 pings 4. Compare audio and video presentation to memory of previous contacts 5. Determine range and bearing from appropriate indicators	1. Pattern of video and/or audio signals 2. Cursor and video pattern 3. Cursor and video pattern 4. Audio and video presentation 5. Range & bearing info. Bearing accurate to $\pm 2^\circ$ Range accurate to ± 10 yds within 3 pings	1. Contact and classification procedures
or Contact range		6. Shift to ping-listen-train sequence 7. If bearing foul may resume standard beam-to-beam search; if bearing clear, classify 8. Classify contact 9. Note audio and video presentation	6. To train after determination of target movement 8. Classification of contact 9. Determine after cut	7. Conn reports bearing "clear" or "foul" 8. Target classification procedures
doppler low or no		10. Determine probable target aspect (compare pitch of echo to reverbs)	10. Determine doppler 11. Optimum presentation	10. Pitch of echo & associated reverbs 11. Relative loudness & brightness of various signals
ading cut		12. Note audio and video presentation	12. Determine leading cut 13. Determine target width	
get width				

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER
	14			14. Report echo quality	14. Discriminate echo quality as mushy, or m from memory contacts
	15			15. Report classification	15. Evaluate Classify target as either "sub" "non-submarine" determined above information in memory of previous contacts
	16	16. Video Switch	16. May turn to Difference		
	17	17. Train Control	17. Train to center of target		
	18	18. Range Control	18. Train to center of target	18. Report on target	
	19	19. Director Control Switch	19. Turn to sonar on target		

VIORS

BASIS FOR ACTION

ACTION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
echo quality	14. Discriminate between echo qualities (sharp, mushy, or metallic) from memory of previous contacts	14. Determine echo quality	14. Audio signal	
classification	15. Evaluate information. Classify target as either "submarine", "non-submarine" or "undetermined" in terms of above information and memory of previous contacts	15. Target classification within 30 seconds of contact	15. Audio and video presentation	
on target		16. Optimum presentation for holding contact 17. Hold and track target 18. Hold and track target 19. Switch points to sonar on target	17. Relation of tip of cursor to target blip 18. Relation of tip of cursor to target blip	

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER
E. Maintain Contact	1	1. Target Centered Display Control	1. Turn to TCD, if in SCD		1. Check display
	2	2. Director Control Switch	2. Turn to SONAR ON TARGET if A/D on board	2. "ON TARGET" if no A/D	
	3	3. Master Gain Control	3. Adjust to attain goal		3. Check appearance of noise and reverberation
	4	4. Train and range controls	4. Continuously adjust to maintain cursor tip on leading one-third of target*		4. Determine target edge from memory past target position. Use "ping-pong" sequence.
	5	5. Video Switch	5. Turn to DIFFERENCE		
	6	6. Pulse Length Switch	6. Turn to SHORT Pulse		
	7	7. Stabilization Switch	7. Turn ON		
	8	8. Director Control Switch	8. Turn to DIRECTOR ON if applicable		8. Check to make sure DIRECTOR ON position
	9	9. Dwell Time Switch	9. Turn to Position 2 or 3 (or alternate as directed by A/S officer)*		9. Determination is most
	10	10. Ships Speed Control	10. Adjust to value of own ship's speed		10. Check own speed
	11			11. "Bearing _____, Range _____" every three pings, if no A/D on board	11. Read bearing and range from range dials on board
	12			12. "Target angle or target aspect"	12. Determine target aspect angle

* Tentative pending further research results

S		BASIS FOR ACTION		
ION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
no	<p>1. Check display mode</p> <p>3. Check appearance of noise and reverbs</p> <p>4. Determine leading edge from memory of past target positions. Use "ping-listen-train" sequence.</p>	<p>1. Scope in TCD</p> <p>2. Inform director operator or A/S officer that sonar is on target</p> <p>3. Suppress excessive noise and reverbs to reduce possibility of losing contact</p> <p>4. Provide accurate range and bearing information to A/D or A/S officer.</p> <p>5. Greater target definition for greater accuracy</p> <p>6. Same as 5</p> <p>7. Stabilize transducer</p> <p>8. Check to see if DIRECTOR ON pilot is on</p> <p>9. Determine which position is most comfortable</p> <p>10. Check own ship's speed</p> <p>11. Read bearing and range dials if no A/D on board</p> <p>12. Determine target aspect angle</p>	<p>3. Intensity of noise and reverbs.</p> <p>4. Persistence of target's last position(s)</p> <p>8. DIRECTOR ON pilot light is on</p> <p>9. Duration of cursor print time</p> <p>10. Match own ship's speed</p> <p>11. Range and bearing dials</p> <p>12. Angle formed by longitudinal axis of video echo and cursor, doppler, and video echo configuration</p>	<p>1. Acquire</p> <p>3. Optimum intensity level</p> <p>4. Knowledge of relative motion</p> <p>9. Order to alternate dwell times</p> <p>10. Reported value of own ship's speed</p>
on				
or				

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	№	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER A
	13.			13. "Doppler _____" every other ping	13. Compare with last port reverbs
	13a	13a. Pulse Length Switch	13a. Switch to Medium or Long if necessary to determine doppler		13a. Decide the target cannot be detected by short pulse
	14			14. "Bearing Drift _____" or "Bearing Steady", every other ping starting with ping after doppler report	14. Determine bearing drift by remembering previous target bearing and noting period of preceding bearing echoes
	15			15. "Range (Opening, Closing or Steady)"	15. Determine range movement by scope and dial
	16	16. Range Scale Selector Switch	16. Turn to next lower range scale		16. Be alert for range cue
	17	17. Transmission Selector Switch	17. Turn to MCC XMIT between 2000 and 2500 yds.		17. Check appearance of CRT
	18	18. Range Scale Selector Switch	18. Turn to 1000 yard scale		18. Be alert for range cue
	*19	19. Target Centered Display Control	19. Turn to SCD		19. Note and record position of target
	20	20. Transmission Selector Switch	20. Turn to MCC at 300 yards or when target begins to fade		20. Note when target closes to 300 yards

* Tentative pending further research results

RS		BASIS FOR ACTION		
TION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
"	13. Compare audio echo with last portion of reverbs 13a. Decide that doppler cannot be determined on short pulse	13. Provide A/S officer or A/D operator with target 13a. Accurate doppler information	13. Pitch of audio echo and reverbs 13a. Poor echo quality	13. Meaning of doppler 13a. Easier to determine doppler from longer pulse echoes
ft dy", start- ter	14. Determine bearing drift by remembering previous target bearings and noting persistence of preceding video echoes	14. Inform director operator or A/S officer of target movement	14. Persistence of preceding video echoes	
ding, y)"	15. Determine target range movement from scope and dials 16. Be alert to display cue 17. Check appearance of CRT 18. Be alert to display cue 19. Note and remember position of target 20. Note when target closes to 300 yards	15. Same as 14 16. Keep target out of noise and reverbs as much as possible 17. Reduce surface reverbs, noise and interference between ships. Ensonify depth equipment 18. Keep target out of noise and reverbs as much as possible 19. Avoid losing contact due to control problems 20. Maintenance of contact at short range	15. Same as 14 16. Appearance of an intense, wide band across the CRT 17. Excessive surface reverbs and noise 18. Appearance of an intense, wide band across the CRT 19. Target below 1000 yards 20. Target reaches 2/3 in on scope on 1000 yard scale or it begins to fade	

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER ACT
F. Long range lost contact (no echo)	1			1. No echo (within 5 pings)	1. Decide that contact is really lost
	2			2. "Last bearing _____, last range _____"	2. Read tgt. brg. range at lost contact and remember
	3	3. Slew Switches	3. Depress RANGE OUT button; slew to approximately 500 yds beyond last target range		3. Remember target at lost contact. range dial
	4	4. Range Scale Selector Switch	4. If necessary turn to scale including new cursor range (see ##)		4. Check if range includes new cursor range
	5	5. Train Control (or slew buttons)	5. Train (or slew) 20° aft of last known bearing of target or following special order	5. Repeat special order if given	5. Remember last bearing
	6	6. Train Control	6. Train forward in 5° steps to search thru 40° arc		6. Search for target following ping-train listen sequence. to display cue
	7	7. Target Centered Display Control	7. Turn to SCD		
	8	Video Switch	8. Turn to SUM		
	9	9. Pulse Length Switch	9. Turn to MED		
	10	10. Dwell Time Switch	10. Turn to Position #1		
	11	11. Master Gain Control	11. Rotate clockwise (raise) slightly		11. Check appearance of video display
	12			12. "Lost Contact" (within one ping after no-echo procedure completed)	
	13			13. "Last bearing _____, last range _____." immediately after lost contact report	13. Remember last bearing and range

RS		BASIS FOR ACTION		
ITION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
in 5	<p>1. Decide that contact is really lost</p> <p>2. Read tgt. brg. and range at lost contact and remember</p> <p>3. Remember target range at lost contact. Check range dial</p> <p>4. Check if range scale includes new cursor range</p>	<p>1. Inform A/S officer that contact is lost</p> <p>2. Inform ASO of target's last position</p> <p>3. Extend cursor beyond possible range of target to be sure to regain contact</p> <p>4. Transmit to new cursor range</p>	<p>1. Target has not appeared for 5 pings</p>	<p>1. No echo procedures</p>
1 order	<p>5. Remember last target bearing</p> <p>6. Search for target following ping-train-listen sequence. Attend to display cue</p>	<p>5. Cursor positioned 20° aft of last target bearing. 3° tolerance</p> <p>6. Regain contact</p> <p>7. Scope in SCD for 360° coverage</p> <p>8. Sum presentation for greater probability of detection</p> <p>9. Mod pulse for greater probability of detection</p> <p>10. More information</p>	<p>6. Cursor position and bearing dial reading.</p>	<p>5. Search a particular arc.</p>
	<p>11. Check appearance of video display</p>	<p>11. Gain sufficiently high to detect possible contact and yet comfortable</p>	<p>11. Video picture too weak for target detection</p>	
		<p>12. Inform A/S officer that contact is lost</p>	<p>12. No target was found during search</p>	
	<p>13. Remember last bearing and range</p>	<p>13. Inform A/S officer of last known target position</p>		

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER AC
	14	14. Slew switches	14. Depress bearing slew button to slew aft to baffles on side which contact was lost or follow special order	14. Repeat special order	14. Remember side contact w Note position and nearest range of day
	15	15. Slew switches	15. Depress RANGE OUT button and slew to range of day		15. Remember range of day
	16	16. Range Scale Selector Switch	16. Turn to scale which includes range of day		16. Remember range of day
	17	17. Train Control	17. Train forward in 5 steps to bow		17. Search for following ping listen
	18			18. Request search arc after completion of lost contact procedure	
	19	FOLLOW "SEARCH AN ARC" PROCEDURE PREVIOUSLY DESCRIBED			
	20			20. "Regained contact, Bearing ____ Range ____" on first echo	20. Read bearing range dials

DRS		BASIS FOR ACTION		
CTION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
cial order	14. Remember which side contact was lost. Note position of cursor and nearest route to baffles	14. Cursor positioned at baffles on side contact was lost	14. Relative positions of cursor and baffles	14. Lost Contact procedures
	15. Remember range of day	15. Extension of cursor beyond possible range of target	15. Position of cursor in range	15. Range of day
	16. Remember range of day	16. Transmit to range of day		
	17. Search for target following ping-train-listen	17. Regain contact	17. Cursor position and bearing dial reading	
search arc on of procedure		18. Regain contact	18. No target was found during search	
contact, range ____"	20. Read bearing and range dials	20. Inform ASO of target position	20. Bearing and range dial readings	

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER ACT
G. Short range lost contact	1	1. Transmission Selector Switch	1. Turn to MCC if not in MCC		1. Check to make switch is in MCC
	2			2. "Lost Contact due to short range" (within two pings)	
	3			3. "Last Bearing ____; Last Range ____" (within two pings)	3. Read target bearing at lost and remember
	4	4. Slew Switches	4. Depress RANGE OUT button; slew to 500 yds beyond last target		4. Remember last range
	5	5. Master Gain Control	5. Rotate clockwise (raise) slightly		5. Check appearance video display
	6	6. Target Centered Display Control	6. Turn to SCD if not there		6. Make sure scope in SCD
	7	7. Range Scale Selector Switch	7. Turn to LISTEN at Fire 1		7. Listen for Fire 1 order
	8	8. Slew Switches	8. Depress bearing slew button; slew beam to beam via stern, back & forth after Fire 1 order or follow order to listen thru a particular arc	8. Repeat special order	8. Note position cursor; start slew from nearest beam. Listen for target sounds. Follow listening sweep procedure
	9	9. Range Scale Selector Switch	9. Turn to 1000 yard scale		
	10	10. Video Switch	10. Turn to SUM		
	11	11. Pulse Length Switch	11. Turn to MED		
	12	12. Dwell Time Switch	12. Turn to Position #1		

S		BASIS FOR ACTION		
ION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
due to min ;	<p>1. Check to make sure switch is in MCC</p> <p>2. Inform ASO that contact has been lost</p> <p>3. Read target range & bearing at lost contact and remember</p> <p>4. Remember last target range</p> <p>5. Check appearance of video display</p> <p>6. Make sure scope is in SCD</p> <p>7. Listen for Fire 1 order</p> <p>8. Note position of cursor; start slew from nearest beam. Listen for target sounds. Follow listening sweep procedure</p> <p>9. Proper range scale for target detection</p> <p>10. Sum presentation for greater probability of detection</p> <p>11. Mod. pulse for greater probability of detection</p> <p>12. More information</p>	<p>1. Switch in MCC</p> <p>2. Inform ASO of target's last position</p> <p>3. Extend cursor beyond possible range of target to be sure to regain contact</p> <p>4. Gain sufficiently high to detect target and yet comfortable</p> <p>5. Scope in SCD for 360° coverage</p> <p>6. Console in LISTEN at Fire 1</p> <p>7. Detection of target by listening for its noise output</p> <p>8. Target cavitation or auxiliary noises</p>	<p>1. No target on scope</p> <p>2. No target on scope</p>	<p>1. Lost contact procedures</p> <p>8. Order to conduct a listening sweep through a particular arc. Lost contact and "conduct a listening sweep" procedures</p> <p>9. Lost contact procedures</p>

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER A
	13	13. Train Control (or Slew Button)	13. Train (or slew) to forward part of baffles on side contact was lost.		13. Check cur- tion. Determin- can train or
	14	14. Train Control (& slew buttons)	14. Train forward in 5° steps to beam, slew thru bow to opposite beam, train aft in 5° steps thru baffles to opposite beam or follow special order	14. Repeat special order	14. Search for following ping listen sequenc when have tra proper beam. to display cur
	15			15. Request search arc after completion of #14	
	16	FOLLOW "SEARCH AN ARC" PROCEDURE PREVIOUSLY DESCRIBED			
	17	17. Transmission Selector Switch	17. Turn to MCC-XMIT when O/S is 700 yards beyond datum point		17. Remember point
	18			18. "Regained contact, Brg _____, Range ____." on first echo	18. Read bear- range dials
	19	19. Train and Range Controls (& slew buttons)	19. Adjust controls (or slew) to position cursor on target		19. Note posi- cursor with re- to target. De- whether need
	20			20. "On Target"	

DRS		BASIS FOR ACTION		
ACTION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
cial	13. Check cursor position. Determine whether can train or must slew 14. Search for target following ping-train-listen sequence. Slew when have trained to proper beam. Attend to display cue	13. Cursor positioned on forward part of baffles on side contact was lost 14. Regain contact	13. Position of O/S baffles 14. Cursor position and bearing dial reading	14. Special order to search a particular arc
arch arc on of #14		15. Regain contact	15. No target was found during search	
contact, " ."	17. Remember datum point 18. Read bearing and range dials 19. Note position of cursor with respect to target. Determine whether need to slew	17. Proper conditions for regain contact 18. Inform ASO of target position 19. Cursor tip on target	18. Bearing and range dial readings 19. Position of cursor relative to target	17. Datum point
		20. Inform ASO that sonar is on target	20. Position of cursor relative to target	

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER
H. Search an arc	1			1. Repeat order (verbatim)	
	2	2. Target Centered Display Control	2. Turn to SCD if an TCD		2. Check no display
	3	3. Range Scale Selector Switch	3. Turn to longest effective range		3. Check range in use
	4	4. Slew Switches	4. Depress right (or left) button, slew to after limit of arc		4. Remember
	5	5. Train Control	5. Train forward in 5° steps		5. Use ping listen sequence
	6	6. Video Switch	6. Turn to sum brightening if in difference		6. Check thing
	7	7. Pulse Length Switch	7. Turn to optimum pulse length for search		7. Check pulse
	8	8. Master Gain Control	8. Adjust for search		
	9	9. Dwell Time Switch	9. Turn to Position 1		9. Check dwell
	10			10. Arc searched. No echoes	
	11	11. Train Control	11. Train back through arc		11. Continue arc
	12			12. Report after each search	

RS		BASIS FOR ACTION		
TION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
	<p>2. Check mode of display</p> <p>3. Check range scale in use</p> <p>4. Remember after limit</p> <p>5. Use ping train-listen sequence</p> <p>6. Check the brightening</p> <p>7. Check pulse length</p> <p>9. Check dwell time</p> <p>11. Continue to search arc</p>	<p>2. Scope in SCD</p> <p>3. Longest effective range</p> <p>4. Cursor on after limit of arc</p> <p>5. Detection of contacts</p> <p>6. In sum brightening</p> <p>7. Optimum pulse length</p> <p>9. Dwell time on Position 1</p>	<p>3. Speed of sweep position of range switch</p> <p>4. Relative position of cursor & bearing dial</p> <p>5. Cursor position in relation to bearing dial and video and audio signals</p> <p>8. Appearance of noise & reverbs</p> <p>10. Absence of echo pattern or audio signal indicating echo</p> <p>11. Same as 5</p> <p>12. Same as 10</p>	<p>1. Search a designated arc. Search an arc procedure</p> <p>3. Range of day</p>

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER
I. Investigate an arc	1			1. Repeat order verbatim	
	2	2. Target Centered Display Control	2. Turn to SCD if in TCD		2. Check mode
	3	3. Range Scale Selector Switch	3. Turn to longest effective range		3. Check range use. Remember day.
	4	4. Slew Switches	4. Depress right (or left) button. Slew to after bearing of designated arc.		4. Remember
	5	5. Train Control	5. Train forward in $2\frac{1}{2}$ steps		5. Remember limit of arc visual and Use ping train sequence.
	6	6. Video Switch	6. Turn to sum brightening if in difference brightening		6. Memory of position of switch
	7	7. Pulse Length Switch	7. Turn to medium pulse		7. Remember length in train
	8	8. Dwell Time Switch	8. Turn to dwell time 1		8. Check dwell time
	9	9. Master Gain Control	9. Adjust to optimum gain for search		
	10	10. Train Control	10. Ping twice on forward limit		10. Same as 5
	11	*		11. "Arc investigated. No results."	
	12	12. Slew Switches	12. Depress right (or left) button. Slew to proper beam		12. Resume in accordance with search plan

		BASIS FOR ACTION		
ON	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
rbatin	<p>2. Check mode of display</p> <p>3. Check range scale in use. Remember range of day.</p> <p>4. Remember after limit</p> <p>5. Remember forward limit of arc. Make visual and audio search. Use ping train-listen sequence.</p> <p>6. Memory of last position of switch check</p> <p>7. Remember pulse length in use - check.</p> <p>8. Check - remember dwell time in use</p> <p>10. Same as 5</p> <p>12. Resume echo ranging in accordance with ⁱⁿ search plan-effect.</p>	<p>2. Scope in SCD</p> <p>4. Cursor on after limit of arc</p> <p>5. Reaching forward limit by steps. Contact detection.</p> <p>6. Scope displays sum brightening</p> <p>7. Medium pulse length</p> <p>8. Use of dwell time</p> <p>9. Sufficient gain to detect faint contacts, not blanked by noise</p> <p>10. Two pings on forward limit</p>	<p>2. Scope appearance - origin of sweep</p> <p>3. Speed of sweep position of switch</p> <p>4. Relative position of cursor and bearing dial</p> <p>5. Cursor position in relation to bearing dial, scope appearance, & character of signal</p> <p>6. Appearance of reverbs</p> <p>7. Scope appearance or switch position</p> <p>8. Position of switch. Duration of cursor print</p> <p>9. Appearance of scope with respect to reverbs & noise</p> <p>10. Position of cursor with respect to bearing dial</p> <p>11. No video pattern or audio signals indicating contact</p>	<p>1. Investigate a designated arc. Investigate an arc procedure.</p> <p>3. Range of day</p>

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER
J. Conduct a listening sweep	1			1. Repeat order verbatim	
	2	2. Range Scale Selector Switch	2. Turn range switch to listen		
	3	3. Master Gain Control	3. Adjust master gain for listening		
	4	4. Slew Switches	4. Depress right (or left) button. Slew to after limit of listening arc		4. Remember Be alert to video or audio
	5	5. Train Control	5. Train forward through arc at 12° per sec.		5. Remain alert to signals
	6	6. Train Control	6. Train back through the arc		6. Listen and Remember arc
	7			7. Report results of listening sweep	7. Resume operation in accordance with search plan

RS		BASIS FOR ACTION		
TION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
verbatim	<p>4. Remember after limit Be alert to signals video or audio.</p> <p>5. Remain alert for signals</p> <p>6. Listen as he trains. Remember arc limits</p> <p>7. Resume echo ranging in accordance with search plan</p>	<p>2. Keying stops</p> <p>4. Cursor at after limit</p> <p>5. Uniform progress of cursor on scope</p> <p>6. Return to forward arc</p>	<p>3. Brightness of noise on scope and audio level</p> <p>4. Relative position of cursor & bearing dial, video and audio signals, particularly noise wedges and associated audio</p> <p>5. Video patterns on scope & noise signals</p> <p>6. Same as 4 and 5</p> <p>7. Video pattern and associated audio signal indicating no contact</p>	<p>1. Order to conduct a listening sweep. Listening Sweep Doctrine</p>

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DESCRIPTIVE INFORMATION			BEHAVIORS		
TASK	NO	CONTROL DESCRIPTION	CONTROL ACTION	REPORT ACTION	OTHER
K. Secure SQS-4 Sonar Stack	1			1. Request permission to secure from OOD or A/S Officer	
	2				
	3	3. Master Gain Control	3. Turn to zero		
	4	4. Range Scale Selector Switch	4. Turn to Listen		
	5	5. Power Switch	5. Turn to Off		
	6			6. Report SQS-4 secured	

BASIS FOR ACTION				
ACTION	OTHER ACTION	GOAL-CRITERION OF RESPONSE ADEQUACY	DISPLAY CUES	SPECIAL ORDERS DOCTRINE & GENERAL KNOWLEDGE
ermission om OOD or S-4 secured		1. Secure stack 5. Indicators not lit		1. Securing procedures 2. Permission granted

J